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LEVERAGING TECHNOLOGY FOR STRATEGIC ADVANTAGE IN THE GLOBAL MARKET : CASE OF THE KOREAN ELECTRONICS INDUSTRY

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KOREA INSTITUTE FOR INTERNATIONAL ECONOMIC POLICY

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Ⅰ. Introduction

Success of the Korean Consumer Electronics Industry

The fact that Korean electronics corporations, such as Samsung, Daewoo and Goldstar, have become household names in countries far outside of Asia testifies to the extraordinary success experienced by the Korean consumer electronics industry in the global market over the past twenty years. Indeed, if it is correct to call Korea's post-war economic boom a "miracle" as it is commonly referred to today, then the remarkable growth of the Korean consumer electronics industry lacks any sort of adequate description.

Betweeen 1985 and 1992, the Korean electronics industry grew at an average rate of 22.9 percent per year(Table 1). Furthermore, the Korean electronics industry has displayed remarkable progress in terms of both product quality and diversification. During its early stages in the 1960's and 1970's, the Korean consumer electronics industry concerned itself mainly with assemblying foreign parts, usually for vacuum tube radios and black and white television sets. During the eighties, however, the Korean consumer electronics industry has diversified its technological capabilities with such products as compact disk players, camcorders, and digital audio tape, not to mention color television sets and microwave ovens. The industry has shifted from consumer-oriented production to industrial production centered on technology-intensive processes.

〈Table 1〉 Status of Electronics Industry in Korea

(Million US$,%)

	1970	1980	1985	1990	1991	1992	Annual Growth rate (1985-92)
Production							
GNP(A)	8,800	60,500	83,100	242,300	281,800	294,500	20.4
Electronics(B)	106	2,852	8,460	29,711	33,088	33,407	22.9
Consumer Electronics(C)	30	1,148	3,586	10,261	11,048	10,545	18.0
B/A	1.2	4.7	10.2	12.3	11.7	11.3	—
C/A	0.3	1.9	4.3	4.2	3.9	3.6	—
C/B	28.3	40.3	42.4	34.5	33.4	31.6	—
Exports							
Total Exports(D)	835	17,505	30,283	64,016	71,870	76,632	14.6
Electronics(E)	55	2,004	4,532	17,215	19,334	20,683	26.2
Consumer Electronics(F)	9	985	1,839	5,529	6,054	5,966	29.3
E/D	6.6	11.4	15.0	26.5	26.9	27.0	—
F/D	1.1	6.6	6.1	8.5	8.4	7.8	—
F/E	16.4	49.2	40.6	32.1	31.3	28.8	—

Notes : 1) Since GNP is value-added and electronics is sales, the ratios in the table should be carefully interpreted.

2) Amounts and growth rates are based on current prices.

Sources : Bank of Korea, Electronic Industries Association of Korea

Today, Korea is the third largest producer in the world of consumer electronic products and components, and Korean electronics have become the world's third largest industry. It is also the third largest exporter of consumer electronics, but ranks fifth with the inclusion of components and re-exports(Table 2,3).

In 1970, Korea sold 55 million U.S. dollars worth of electronics to the world market. In 1992, two decades later, that figure has skyrocketed to 20.7 billion U.S. dollars, over 6 percent of the world market. Despite

〈Table 2〉 Electronics Production of Major Countries, 1990

(Million US$)

	E D P	Office Equipment	Control & Instr	Medical & Industrial	Comms & Military	Telecomm-unication	Consumer	Components	Total
Brazil	4634	315	600	210	680	1516	2170	2082	12207
Japan	53207	5166	3834	4931	9200	14579	32069	58641	184628
Singapore	6864	313	197	59	276	222	2177	4777	14885
Korea	3181	265	197	171	697	1756	6305	10539	23111
Taiwan	4944	303	83	190	596	1311	1824	4948	14199
USA	48616	5434	25450	8924	50619	15488	6518	41376	202425
World Total	130047	12511	35343	15638	66224	41207	59301	126835	487104

notes : 1) Current figures at current exchange rates

2) The correction for semiconductor assembly is an estimate of the value of chips and wafers shipped to Far East countries for assembly and corrects for double counting of these goods.

source : Elsevier Advanced Technology, *Yearbook of World Electronics Data*, 1993.

〈Table 3〉 Electronics Exports of Major Countries, 1990

(Million US$)

	E D P	Office Equipment	Control & Instr	Medical & Industrial	Comms & Military	Telecomm-unication	Consumer	Components			Total
								Active	Passive	Other	
Hong Kong	2706	731	218	187	831	941	6576	2303	938	2155	17586
Japan	18772	3434	3110	1710	3297	4062	20200	11621	4552	5441	76200
Singapore	8705	324	389	44	369	293	3659	3407	724	1860	19773
Korea	2447	113	210	49	409	539	4491	5209	506	1709	15682
Taiwan	5504	292	165	94	538	722	1554	2182	1186	1225	13462
USA	22305	406	6410	2845	3415	2400	1263	4910	3315	2947	50216
World Total	65819	5476	11293	5257	10135	10820	41106	37264	13091	16661	216921

notes : 1) Current figures at current exchange rates. Exports include re-exports.

2) The correction for semiconductor assembly is an estimate of the value of chips and wafers shipped to Far East countries for assembly and corrects for double counting of these goods.

Source : Elsevier Advanced Technology, *Yearbook of World Electronics Data*, 1993.

growing trade restrictions by the U.S. and by the EC, Korean-manufactured personal computers and VCR's now occupy an impressive share of their respective markets all around the globe, with exports representing more than three-quarters of total production.

Methodological Questions

Why has the Korean electronics industry—an obvious latecomer—been so successful? Can this trend continue? And what lessons does this specific case provide, if any, for other industrializing nations?

These are the issues which will be discussed in this paper. But in order to gain a better appreciation for the complexities involved in these topics, one must first understand what has made the consumer electronics industry unique from other industries in recent Korean history.

Ⅱ. History of the Korean Consumer Electronics Industry

Foreign Investment

More than most of Korea's other developing industries, the consumer electronics industry has relied quite substantially on foreign investment throughout its short history, typically in the form of Original Equipment Manufacture(OEM) agreements.

This is understandable as Korea, during the early stages, possessed very little indigenous technology in the area of consumer electronics. At the same time, however, its workers provided a reliable and cheap source of labor for foreign(usually American and later Japanese) companies. As one political economist perceptively pointed out:

"Once the decision for export-led growth had been taken, Korean electronics manufactures had no choice···with a limited technology base, negligible brand recognition overseas and no international marketing presence, there were few alternatives for an industry, such as electronics, where technology–and thereby products—is continually changing. Korean companies were, thus, heavily dependent on OEM agreements to provide both technology and access to overseas markets."[1)]

Unfortunately, many of these early agreements initially did not provide much opportunity for the transfer of electronics technology to Korea. A large number of these operations were wholly owned by foreign corporations and employed Korean companies and their workers merely to produce components. Nevertheless, a very limited amount of technical know-how was diffused through the Korean industry with the increasing presence of foreign engineers and production managers who brought their technical expertise with them to Korea.

The contribution of foreign firms to the production and exports of the Korean electronics industry has declined over time although they still

1) Bloom, Martin, *Technological Change in the Korean Electronics Industry*, (OECD, 1992) p.13.

maintain significant shares in electronics production and exports. For example, firms with foreign capital produced 15.9 percent of total domestic consumer electronics production and exported 25.5 percent of all Korean electronics exported in 1982. However, their shares in 1990 are 6.0 percent and 9.2 percent, respectively (Table 4).

〈Table 4〉 Share of Production and Export of Consumer Electronics by Type of Company in Korea

(%)

	1982		1985		1990	
	Production	**Export**	**Production**	**Export**	**Production**	**Export**
Local Firms	84.1	74.5	88.9	83.2	94.0	90.8
Joint Ventures	4.9	6.1	5.4	7.7	4.8	6.0
Foreign Firms	11.0	19.4	5.7	9.1	1.2	3.2

Source : Electronic Industries Association of Korea

The Role of the Korean Government

Outside assistance was undeniably a base for the Korean consumer electronics industry. However, this was a precarious foundation. In a state-of-the-art industry, such as consumer electronics, a much more advanced level of indigenous technological sophistication was required in order for a country like Korea to have and maintain a competitive industry in the global market.

Hence, the Korean government began in the mid-sixties to undertake an active role in solidifying the foundation of technological know-how and in constructing a research edifice for the future.

The Korea Institute for Science and Technology(KIST) was founded

in 1966 to encourage more research and development in Korea and to attract more foreign technology and foreign-trained Korean scientists back to Korea. In 1973, the National Council for Science and Technology, chaired by the Prime Minister of Korea, was formed and began to evaluate goals and plans for spurring the growth of indigenous technology. That same year, the landmark Law of the Promotion of Industrial Technology Development was introduced by the Korean government. Recognizing the low level of technology and research within Korean industries, the Law of the Promotion of Industrial Technological Development forced the electronics industry to carry out research activities aimed at commercializing technology necessary for export.

Finally, in the mid-seventies, even more specialized policies were undertaken by the Korean government to promote research in key industrial sectors. In 1976, for example, The Korea Institute of Electronics Technology (KIET) was formed to direct such crucial research projects as semi-conductor development, IC design and wafer production[2]. Two years later, the Applied Optics Laboratory of KIST began Korean research into fiber optical technology, such as multimode, and later single-mode fibers.

2) KIET was merged with the Korea Electrotechnology and Telecommunications Research Institute in 1985 to become the Electronics and Telecommunications Research Institute(ETRI), a leading government-sponsored research institute with over thousand researchers.

The Development of Korea's Indigenous Technology Capabilities

These numerous government agencies and institutes, which sprouted up in the sixties, seventies, and eighties, all worked to develop Korea's indigenous technological capabilities by promoting research within the Korean industry, itself. Government research institutes, such as KIET and KIST, all worked closely with the consumer electronics industry. However, research goals were never aimed at pure, theoretical science, but, rather, at the development of products for export.

Government policy was undeniably the chief catalyst for the burgeoning growth of private industry research, which Korea experienced in subsequent years. Private research and development in electronics now dwarfs government expenditures. Although as late as 1965, around 90% of all research and development expenditures in Korea was provided by the government, that percentage has steadily decreased over the past thirty years, as private industry has begun to increasingly bear the burden of R&D, following government incentives. Today, less than 20% of total R&D expenditures comes from the government, although cooperation between government research agencies and private industries still remains extremely close (Table 5).

State Financing of R&D and Tax Incentives

Furthermore, during the eighties, the Korean government has pur-

〈Table 5〉 Major R&D Indicators in Korea

	1970	1975	1980	1985	1990	1991
R&D Expenditures (Bill.Won)	10.5	42.7	282.5	1,237.1	3,349.9	4,158.4
Gov't Sources (Bill.Won)	7.5	28.5	180.0	306.8	651.0	815.8
Private Sources (Bill.Won)	3.0	14.2	102.5	930.3	2,698.9	3,342.6
Gov't VS. Private	70.3:28.7	66.7:33.3	63.7:36.3	248:75.2	19.4:80.6	19.6:80.4
Manufacturing (Bill.Won)	1.3[a]	12.3	81.4	751.0	2,374.5	2,965.6
R&D / sales	n.a	0.39[b]	0.50	1.51	1.96	2.02
R&D / GNP	0.38	0.42	0.77	1.58	1.95	2.02
Number of Researchers[c] (Persons)	5,628	10,275	18,434	41,473	70,503	76,252
Gov't / public Inst. (Persons)	2,458	5,308	4,598	7,154	10,434	10,529
Universities (Persons)	2,011	2,312	8,695	14,935	21,332	20,680
Private sector (Persons)	1,159	2,655	5,141	18,996	38,737	45,043
R&D exp. / researcher (Mill.Won)	1.9	4.2	15.3	29.8	47.5	54.5
Research / 1,000 Population (Persons)	0.18	0.29	0.48	0.10	1.64	1.76
Number of Corporate R&D laboratories (EA)	n.a.	n.a.	54	170	1,201	1,435

Notes : [a] 1971 figure b 1976 figure

[b] The figures do not include research assistants, technicians, and other supporting personnel.

Source : Korea Industrial Technology Association, *Major Indicators of Industrial Technology*, 1993.

sued an increasingly aggressive campaign to promote private R&D through special financing schemes and tax incentives to technology-based corporations. Indeed, by 1987, almost 95% of all corporate R&D in Korea was financed through preferential loans from the state. Numerous tax incentives, such as:

1) the reduction or outright elimination of tariffs on imports of R& D equipment and supplies,
2) the deduction of non-capital R&D expenditures and human re-

source development costs from taxable corporate income,

3) the accelerated depreciation of industrial R&D facilities, and

4) the exemption of real estate taxes on R&D-related properties.[3)]

All of these incentives contributed to an economic climate in which the private sector was actively encouraged to establish its own technological infrastructure, and, thereby, ultimately reduce its dependence on foreign technology. The government also established a program called the Technology Development Reserve Fund, which allowed corporations to reduce their taxes even further by setting aside 20-30 percent of all pre-tax profits each year for future R&D.

Effects of Government Policy

These numerous actions by the government have ultimately effected the development of Korea's indigenous technological infrastructure. The development of Korea's technological infrastructure has, in turn, resulted in three major effects on Korea's consumer electronics industry.

First of all, government policy transformed Korea's technological work force from one involved in mainly low-skilled, equipment maintenance- and operation-based tasks, to one involved in cutting edge developments and research. This allowed Korean companies to branch out and

3) cf. Kim, Linsu. "The Structure and Workings of the National Innovation System in Korea", (A paper presented at the "Redefining Korean Competitiveness in an Age of Globalization" Conference: Berkeley, April 24, 1993), p.4.

secure more profitable contracts.

Secondly, it significantly reduced Korea's dependence on foreign technology. Of course, Korea still lagged considerably behind the United States and Japan. However, Korean companies were not totally dependent on foreign corporations for technology as they in the fifties and sixties. The research and development laboratories of Korean consumer electronics corporations were capable of producing independent technological innovations.

Finally, and perhaps most interestingly, Korea's newly-created technological infrastructure has expedited the transfer of technology from foreign countries to Korea in arrangements which are much more favorable to Korea than were previous arrangements. The development of Korea's own indigenous technology through government-led research efforts has paved the way for Korean corporations to procure numerous joint research and development projects, cross-licensing agreements and joint ventures with foreign companies-arrangements which transfer technology much faster than the earlier, exclusively production-oriented arrangements of the fifties and sixties.

Two Case Studies in Licensing

〈Table 6〉 shows that electronics industry has heavily dependent upon licensing from foreign firms. One constructive case study can be seen in the licensing agreements between Philips and several Korean companies

〈Table 6〉 Technology Imports by Industry in Korea

(Million US$)

	Food	textile	Chemical	Metal	Electronics	Machinery	Others	Total
1962-86	21.7	49.6	345.6	92.9	441.8	450.7	347.7	1,750.0
	(146)	(206)	(796)	(293)	(909)	(1,272)	(460)	(4,055)
1987	4.3	8.3	65.4	12.0	197.2	131.3	105.2	523.7
	(24)	(37)	(135)	(31)	(164)	(161)	(85)	(637)
1988	5.2	8.3	112.1	6.0	265.0	126.8	152.9	676.3
	(15)	(52)	(161)	(26)	(212)	(195)	(90)	(751)
1989	8.9	13.2	151.5	10.5	388.4	156.9	159.2	888.6
	(22)	(56)	(150)	(23)	(231)	(168)	(113)	(763)
1990	9.5	14.5	217.1	8.6	467.7	232.6	137.0	1,087.0
	(18)	(44)	(138)	(21)	(219)	(188)	(110)	(738)
1991	14.4	25.2	187.2	6.9	472.6	358.0	119.4	1,183.7
	(16)	(37)	(105)	(13)	(178)	(163)	(70)	(582)
1992	8.8	23.7	110.8	9.2	450.6	131.2	116.3	850.6
	(12)	(18)	(73)	(12)	(194)	(177)	(47)	(533)
Total	72.8	142.8	1,189.7	146.1	2,683.3	1,587.5	1,137.7	6,959.9
	(253)	(450)	(1,531)	(419)	(2,107)	(2,324)	(975)	(8,059)

Note : ( ) is the number of case.

Source : Korea Industrial Technology Association

for the manufacturing of compact disk players. Since Korean electronics corporations possessed most of the technical background for the production of such products, and since Philips, itself, was a major producer of compact disk player deck mechanisms, Philips licensed the remaining technology to ten Korean corporations for unrestricted production of compact disk players. Likewise, when Hitachi wished to shift its own focus from 1 mega DRAM microprocessors to 4 mega DRAM microprocessors, it licensed the technology and provided technical assistance to Goldstar in order to produce 1 mega DRAM microprocessors. This allowed such

corporations to improve their technological base even further.

Such technological transfers have proved to be mutually beneficial for both Korean companies and Philips and Hitachi, respectively. Hitachi continued to earn money from the licensing arrangement for the 1 mega DRAM microprocessors, even though the corporation had subsequently moved on to more state-of-the art technology. Philips increased sales of its highly profitable deck mechanism, while a proliferation of compact disk players brought profits not only from the licensing arrangement itself, but also from increased sales of its compact disk software divisions of Polygram, Deutsche Gramophone, Philips, London and others.

The Korean corporations, on the other hand, in addition to gaining the technology necessary for producing the 1 mega DRAM microprocessor and the compact disk player, also gained the know-how to build and improve such devices through research, thereby gaining valuable knowledge and time. Without technology transfer, as Baranson and Roark point out, "The tens and thousands of elements required for a single industrial product, such as a high speed engine, are meticulously accumulated over time through research and development, through trial and error in equipment and factory methods, and in the detailed specifications and procedures developed through prolonged experience."[4] But, almost as a prerequisite to acquiring technology through such advantageous arrangements, it was essential for Korea to have already developed its own

4) Rosenberg, Nathan and Frischtak, Claudio. *International Technology Transfer : Concepts, Measures and Comparisons* (Praeger Special Studies: New York, 1985), Ch.2, p.25.

indigenous technology.

Hence, whereas in the early sixties, Korea still had only cheap production labor to offer to foreign electronics corporations—an arrangement which, as mentioned earlier, led to minimal technology transfer to Korean workers—by the late seventies, Korean corporations were now in a position to leverage their newly-acquired indigenous technology for more strategic arrangements technology transfer. This success can be attributed to the government-led projects begun ten and twenty years earlier for the development of Korea's technological base and to the efforts of corporations in the private sector.

Direct Purchase of Technology

Furthermore, the development and growth of Korea's consumer electronics industry has also made a much more direct route possible for technology transfer, namely, outright purchase. Samsung, for example, purchased the American company Amperex, one of the world's three manufacturers of magnetrons for microwave ovens and used this technology to produce its own microwave ovens. This contributed to Korea's current 40 percent market share of the global microwave market. In order to acquire the technology to develop its own personal computer software, as well as hardware, Samsung also invested heavily during the mid-eighties in such American computer companies as Micron Technology, Comport, and Micro Five Corporation.

Likewise, Goldstar purchased American corporations, such as Telematic Products, a telecommunications company, and Fonotek, in order to gain crucial telecommunications technology.

These and many other strategic arrangements have led to Korea's spectacular successes in the global consumer electronics market by the early eighties.

Ⅲ. International Competitiveness of the Korean Electronics Industry

Recent Trends

Since its early stages as an infant industry the Korean electronics industry has steadily increased exports overseas. The Korean electronics industry has now become a major exporter, not only to the United States and to Japan, but also to West Germany, the United Kingdom, Hong Kong, Canada, France, Singapore, Malaysia, Italy, the Netherlands, Australia, Spain, Taiwan, and Panama(Table 7). Its exports includ everything from semiconductors, audio equipment, televisions, computers and peripherals, VCR's, microwave ovens, video and audio tapes, telephones, CRT's, and magnetic heads. In 1992, Korean electronics exports totaled 21 billion dollars, with semiconductors sales alone totalling over 7 billion dollars. Samsung Electronics and Goldstar, Korea's two Korean electronics companies each had world sales of over 4 billion dollars. Samsung

〈Table 7〉 Korea's Electronics Exports by Direction

(Million US$,%)

	1987		1992	
	Value	Percentage of Total Value	Value	Percentage of Total Value
Total	11,195	100	20,683	100
United States	4,938	44	6,701	32
Japan	984	9	1,739	8
West Germany	601	5	1,139	6
United Kingdom	598	5	640	3
Hong Kong	523	5	1,305	6
Canada	350	3	429	2
France	331	3	360	2
Singapore	304	3	2,031	10
Malaysia	205	2	625	3
Italy	176	2	196	1
Netherlands	175	2	333	2
Australia	166	2	197	1
Spain	155	1	169	1
Taiwan	149	1	604	3
Panama	109	1	287	1
Others	1,431	12	3,928	19

Source : Electronic Industries Association of Korea, *Statistics of Electronic & Electrical Industries*, 1988, 1993.

quickly rose to 15th place in the Fortune 500 ranking of global corporations (Table 8). The Korean electronics industry was employing 400,000 people by the 1990's (up from 64,000 twenty years earlier), and private companies were employing 3,000 solely for research and development. By 1991, Korea was in control of almost 20% of the DRAM market in the formerly Japanese-and American-dominated semiconductor industry.

The success of the Korean consumer electronics industry has helped launch the Korean economy to become a veritable member of the "Four

〈Table 8〉 Semiconductor Company Ranking, 1992

1992	Semiconductor Total		MOS Memory	
Rank	Company	Revenue	Company	Revenue
1	Intel	5,064	Toshiba	1,622
2	NEC	4,976	Samsung*	1,516
3	Toshiba	4,965	Hitachi	1,512
4	Motorola	4,635	NEC	1,421
5	Hitachi	3,902	Fujitsu	927
6	Texas Instrument	3,052	Mitsubishi	904
7	Fujisu	2,583	Texas Instrument	874
8	Mitsubishi	2,307	Motorola	611
9	Philips	2,108	Goldstar*	557
10	Matsushita	1,929	Hyundai*	556
11	Samsung*	1,902	Sharp	523
12	National Semicon	1,797	Micron Tech.	516
13	SGS-Thomson	1,605	Oki	429
14	AMD	1,502	Intel	324
15	Sharp	1,388	Siemens	315
22	Goldstar*	635		
25	Hyundai*	556		

Note : * Korean firm

Source : Dataquest 1993.

Tiger" East Asian countries. Along with the electronics and other import-related industries, the Korean economy grew at an average annual rate of 9 percent from 1962 to 1991. During the same period, per capita GNP skyrocketed from US$87 to US$6,498. By 1991, exports (including consumer electronics) totaled over US $72 billion. Without the successful transfer of key technology, it is highly unlikely that the Korean economy could have experienced even a fraction of its staggering growth over the past twenty years.

Ⅳ. Technology Transfer and Technological Dependence

Dependence and Developing Countries

In order for developing countries to avoid technological dependence, successful technology transfer must be one key goal. Yet, the conditions for such successful technology transfer are difficult to come by due to many circumstances, including a lack of willingness on the part of foreign firms to offer more than merely a production-assembly arrangement to a developing economy. As I have tried to show in this paper with the case of the Korean consumer electronics industry, the development of a country's own indigenous technological infrastructure is a crucial step in the expedient transfer of favorable technology arrangements between technologically-advanced and technologically-developing countries.

This means that a significant, and, indeed, the primary burden for technological advancement for a developing country is placed on the developing country, itself, to develop an independent, indigenous technological infrastructure which can then be used as a leveraging tool in negotiations for strategic advantage in world markets. As an UNCTAD (United Nations Conference on Trade and Development) report reads:

"If transfer of technology to developing countries is not supported by an appropriate technological infrastructure, the inevitable result would··· be an aggravated state of technological dependence on the advanced countries. Transfer of technology defeats its purpose, or at least becomes

a narrowly conceived activity."[5]

Without earnest and successful efforts to develop the indigenous technological capability of a developing economy, even the most well-intentioned and altruistic arrangements for technological transfer are likely to be unproductive in the long run. With such an infrastructure, however, the developing country gains leverage in securing increasingly advantageous agreements with foreign firms, which often results in further transfer of technology. This has, at least, been the case for the Korean consumer electronics industry.

Indigenous Technological Capabilities and Negotiating Power in Strategic Alliances

Of course, building indigenous technological capabilities is a very difficult task. As the UNCTAD report continues:

"Building indigenous capability—be it in technology generation fields, or in technology utilization production facilities—is unavoidably a complex and protracted endeavor. But it begins and is nurtured by political will based on the consensus among stakeholders in the development process."[6]

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5) Fayez, Mohammed B.E., "Technological Transformations for Developing Countries: Some Factors and Prerequisites", from *Technology Selection, Acquisition and Negotiation : Papers of a Seminar Organized by the Islamic Development Bank and UNCTAD*(United Nations, New York: 1991), p.2.

6) ibid., p.4.

In the case of the Korean consumer electronics industry, this complex process of building indigenous technological capabilities was made easier by several factors. First of all, Korea already possessed a highly literate and capable work force which could work with technology and later adapt it to suit their own purposes. By the mid-1970's, Korea possessed one of the highest literacy rates of any country in the world, with the unique "well-balanced expansion in all levels of education early enough to support its development."[7] Of course, many developing countries do not have the human resources which Korea had at its disposal during the beginning of its economic transformation. A highly skilled work force, however, is a prerequisite for indigenous technology development. One should not be misled by the impression, from the aforementioned remarks, that Korea has achieved self reliance in electronics technology. This is far from reality.

The Korean electronics industry was also aided in the crucial eighties decade by the so called three-lows: 1) low oil prices, 2) low international interest rates, and 3) the low dollar. Finally, Korea experienced relative economic stability by the 1960's, as well as international political support.

At least until the mid-1980s, low labor costs and favorable foreign exchange rates made local consumer electronics very price-competitive on the international market even though they were made with foreign key parts and based on foreign technologies. But comparative labour cost

7) Kim, Linsu. "National System of Industrial Innovation: Dynamics of Capability Building in Korea", (Korea University Working Paper-91-1: Seoul, 1991), p.5.

advantages have eroded recently. Therefore, the development of technology is the most crucial subject for the Korean consumer electronics industry, and the key to future success lies in extensive research and development. The level of technology in the Korean electronics industry nearly matches that of developed countries in terms of designed and generalized products. However, Korea falls behind in both basic engineering and in the production of parts and materials. Fundamental technologies for designing and producing new products are inferior to those in developed countries.

As of 1991, Korean video and audio makers lagged behind their counterparts in advanced countries by a span of 2-4 years in the development of new products; however, this gap widens to 5-7 years in the development of high-tech products for the next generation.

Korea developed color TVs in 1974 as opposed to 1960 in Japan. VCRs were first produced in Korea in 1980 as compared to 1975 in Japan. Camcorders were developed in Korea in 1987 while they had already been produced by Japan in 1984. Korea made plans to develop its High Definition (HD) TV in 1993 and D-VCRs in 1994 even though Japan first developed these products in 1984 and 1987, respectively(Table 9).

Korea's design technology for video products is 50-60 percent the level of Japan's, while its assembly and production technology is 80 percent the level of Japan. Since the 1980's, Korean video and audio manufacturers have relied on receiving up to 78 percent of their technology from foreign sources, especially from the United States and Japan. As a

result, localization of parts and components is still extremely low considering that Korea is on the verge of joining the ranks of the advanced countries in the immediate future.[8)]

〈Table 9〉 Comparison of Product Development Year between Korea and Japan

(year)

	Existing Product					Next Generation Product			
	Color TV	VTR	Camcorder	Super TV	1M DRAM	HDTV	D-VTR	CD application	64M DRAM
Korea	1974	1980	1987	1987	1986	1993	1996	1996	1992
Japan	1960	1975	1984	1982	1973	1984	1989	1989	1991
Gap (year)	14	5	3	5	3	9	7	7	1

Source : Ministry of Trade and Industry.

Against these drawbacks, Korean audio and video makers have been rapidly expanding their investment in R&D projects in order to manufacture high quality and value-added products and to develop their high-tech capabilities to the level of advanced countries(Table 10). They are striving to realize technological self-reliance with the aim of enhancing their international competitiveness. Korea has still a long way to go to achieve self-reliance in the area of electronics technology. However, one cannot deny that it has already made remarkable progress in the indigenization of foreign technologies.

8) Korea Development Bank, "The Current Status and Prospects of the Consumer Electronics Industry in Korea," *Quarterly Industrial Review*(Seoul : KDB), Sept. 1991, p.10.

〈Table 10〉 Facility Investments in Cousumer Electronics Industry in Korea

(Million Won, %)

	Amount			Component		
	1987	1989	1991*	1987	1989	1991*
Capacity Expansion	375.5	287.4	273.3	66.4	52.4	40.7
New products	52.0	108.7	171.3	9.2	19.8	25.5
Existing products	323.5	178.7	102.0	57.2	32.6	15.2
Maintenance	34.6	36.5	72.5	6.1	6.7	10.8
Automation	25.2	34.8	102.3	4.5	6.3	15.2
Research & Development	41.9	66.6	135.0	7.4	12.2	20.1
Other	88.5	122.8	88.9	15.6	22.4	13.2
Total	565.4	548.1	672.0	100.0	100.0	100.0

Note : 1) All figures in the table are calculated at current market prices.

2) * estimate

Source : Korea Development Bank

Ⅴ. Concluding Remarks

Trends and Lessons

Will Korea's consumer electronics industry repeat its successes? Can this trend continue? The future is uncertain. The Korean consumer electronics industry has one of the greatest potential of any industry in Korea, and, indeed, of any industry in Asia. However, the country has yet to attain cutting-edge status in terms of its research for product development. Nevertheless, if the past is any indication of the future, the Korean electronics industry has the potential to catch up with advanced countries in any number of years. However, in either case, it must be noted that the private sector will play a crucial role in determining the course of not only

Korea's consumer electronics industry, but the entire export-oriented economy as a whole.

What lessons does this case provide, if any, for other industrializing nations? First and foremost, a nation must develop its own indigenous technological capabilities in order to gain leverage in much more advantageous technological transfer arrangements. Secondly, the government must play an active role in building such an infrastructure, since it is highly unlikely that it will come about from private initiatives. However, technological innovating should be initiated by the private sector fully utilizing the infrastructure provided by the government. Finally, a highly educated work force and a relatively stable political climate are needed for the development of such an indigenous technological infrastructure.

In hindsight, it may appear as if the successes of the Korean consumer electronics industry has been part of a miraculously fortuitous set of circumstances—a set of circumstances which cannot be found in any other nation. However, as Bloom has pointed out: "It is easy to be misled into thinking that this successful development has been the result of a smooth process, the outcome of systematic and coherent policies. Those who were involved in the early period indicate a haphazard process dependent on personalities, with a high degree of risk, considerable bureaucratic reliance and in-fighting."[9]

9) Bloom, Martin. *Technological Change in the Korean Electronics Industry,* (Development Center Studies: Development Centre of the Organisation of Economic Co-operation and Development, 1992), p. 11.

Infact, the Korean government took many missteps in attempting to develop its consumer electronics industry. In addition to slow action on many issues, the Korean government seriously underinvested in university research. Indeed, the quality of university research and education has actually eroded from the mid-sixties to the present. Most importantly, graduate-level science and engineering education has suffered greatly, and the lack of university research institutions has hampered Korea's progress and will continue to do so in the future.

Predicting the future is impossible. However, the past can serve to offer hope. The past can be studied in order to learn what was possible at one time, and therefore, what still may be possible even today. Korea's consumer electronics industry, if nothing else, can offer hope to less-developed countries working to develop key technology-based industries by developing an indigenous technological infrastructure.

References

Bloom, Martin, *Technological Change in the Korean Electronics Industry,* OECD, 1992.

Elsevier Advanced Technology, *Yearbook of World Electronics Data,* 1993.

Fayez, Mohammed B.E., "Technological Transformations for Developing Countries : Some Factors and Prerequisites," from *Technology Selection, Acquisition and Negotiation : Papers of a Seminar Organized by the Islamic Development Bank and UNCTAD,* United Nations, New York, 1991.

Kim, Linsu. "National System of Industrial Innovation: Dynamics of Capability Building in Korea", Korea University Working Paper-91-1, Seoul, 1991.

Kim, Linsu. "The Structure and Workings of the National Innovation System in Korea", A paper presented at the "Redefining Korean Competitiveness in an Age of Globalization" Conference, Berkeley, April 24, 1993.

Korea Development Bank, *Quarterly Industrial Review,* Seoul, Sept. 1991.

Korea Industrial Technology Association, *Major Indicators of Industrial Technology,* 1993.

Korea Development Bank, "The Current Status and Prospects of the Consumer Electronics Industry in Korea," *Quarterly Industrial Review,* Seoul, Sept. 1991.

Rosenberg, Nathan and Frischtak, Claudio. *International Technology Transfer Concepts, Measures and Comparisons,* Praeger, New York, 1985.